

What is claimed is:

1 1. A method for removing undesired motion
2 from a sequential plurality of related images, each of
3 such images including a stationary component and being
4 fixed within a frame of uniform dimension, said method
5 comprising the steps of:
6 determining a plurality of sequential inter-
7 frame movements of said component over said plurality
8 of frames, each of said inter-frame movements being
9 associated with one of said plurality of frames;
10 choosing a reference frame, said frame having
11 an associated inter-frame movement;
12 measuring the difference between each of said
13 inter-frame movements and the inter-frame movement
14 associated with said reference frame;
15 choosing an image shift parameter;
16 choosing a smoothing filter;
17 designating a test frame;
18 selecting at least one additional frame
19 adjacent said test frame, said frames defining a
20 sample;
21 applying said smoothing filter to the
22 difference values of said sample to obtain a filtered
23 difference value;
24 subtracting the difference associated with
25 said test frame from said filtered value to obtain an
26 image shift value;
27 comparing said image shift value to said

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28 image shift parameter;
29 adjusting the number of frames of said sample
30 in accordance with said comparison;
31 calculating said image shift value on the
32 basis of said adjusted number of frames of said sample;
33 shifting the position of said image with
34 respect to said test frame by said image shift value;
35 designating the next frame of said sequence
36 as said test frame.

1 2. A method as defined in Claim 1 further
2 including the step of enlarging all of said frames of
3 said sequence by a zoom factor related to said image
4 shift parameter.

1 3. A method as defined in Claim 2 wherein
2 the step of adjusting the number of frames of said
3 sample in accordance with said calculated image shift
4 value includes the steps of:

5 increasing the number of frames of said
6 sample when said calculated image shift value is less
7 than said image shift parameter; then

8 calculating an adjusted image shift value in
9 accordance with said increased number of frames;

10 continuing to increase said number of frames
11 of said sample until said image shift value is no
12 longer less than said image shift parameter;

13 decreasing the number of frames of said
14 sample when said image shift value exceeds said image
15 shift parameter.

1 4. A method as defined in Claim 1 wherein
2 the step of choosing a reference frame further includes
3 the step of selecting the first frame of said
4 sequential plurality of related images as said
5 reference frame.

1 5. A method as defined in Claim 1 wherein
2 the step of selecting at least one additional frame
3 further includes the step of selecting unequal numbers
4 of frames prior to and after said test frame in said
5 sequential plurality of related images.

1 6. A method as defined in Claim 1 wherein
2 the step of selecting at least one additional frame
3 further includes the step of selecting equal numbers of
4 frames prior to and after said test frame in said
5 sequential plurality of related images.

1 7. A method as defined in Claim 1 wherein
2 the step of selecting a smoothing filter includes the
3 step of selecting a Gaussian filter.

1 8. A method as defined in Claim 1 wherein
2 the step of selecting a smoothing filter includes the
3 step of selecting a Kalman filter.

1 9. A method as defined in Claim 1 wherein
2 the step of selecting a smoothing filter includes the
3 step of selecting a box filter.

1 10. A method for removing undesired motion
2 from a sequential plurality of related images, each of
3 such images including a stationary component and being
4 fixed within a frame of uniform dimension, said method
5 comprising the steps of:

6 determining a plurality of sequential inter-
7 frame movements of said component over said plurality
8 of frames, each of said inter-frame movements being
9 associated with one of said plurality of frames;

10 choosing a reference frame, said frame having
11 an associated inter-frame movement;

12 measuring the difference between each of said
13 inter-frame movements and the inter-frame movement
14 associated with said reference frame;

15 choosing an image shift parameter;

16 choosing a smoothing filter;

17 designating a test frame;

18 selecting at least one additional frame
19 adjacent said test frame, said frames defining a
20 sample;

21 applying said smoothing filter to difference
22 values of said sample to obtain a filtered difference
23 value;

24 subtracting the difference associated with
25 said test frame from said filtered difference value to
26 obtain an image shift value;

27 shifting the position of said image with
28 respect to said test frame by said image shift value;

29 designating the next frame of said sequence
30 as said test frame;

31 continuing to designate test frames from said
32 sequence until each frame of said sequence has been
33 designated and the image fixed thereon shifted in
34 accordance with said above-described process; and then
35 enlarging all of said frames of said sequence
36 by a zoom factor related to said image shift parameter.

1 11. A method as defined in Claim 10 further
2 including the steps of:
3 comparing said image shift value to said
4 image shift parameter;
5 adjusting the number of frames of said sample
6 in accordance with said comparison;
7 calculating said image shift value on the
8 basis of said adjusted number of frames of said sample.

1 12. A method as defined in Claim 11 wherein
2 the step of adjusting the number of frames of said
3 sample in accordance with said calculated image shift
4 value includes the steps of:

5 increasing the number of frames of said
6 sample when said calculated image shift value is less
7 than said image shift parameter; then

8 calculating an adjusted image shift value in
9 accordance with said increased number of frames;

10 continuing to increase said number of frames
11 of said sample until said image shift value is no
12 longer less than said image shift parameter;

13 decreasing the number of frames of said
14 sample when said image shift value exceeds said image
15 shift parameter.

1 13. A method as defined in Claim 10 wherein
2 the step of choosing a reference frame further includes
3 the step of selecting the first frame of said
4 sequential plurality of related images as said
5 reference frame.

1 14. A method as defined in Claim 10 wherein
2 the step of selecting at least one additional frame
3 further includes the step of selecting unequal numbers
4 of frames prior to and after said test frame in said
5 sequential plurality of related images.

1 15. A method as defined in Claim 10 wherein
2 the step of selecting at least one additional frame
3 further includes the step of selecting equal numbers of
4 frames prior to and after said test frame in said
5 sequential plurality of related images.

1 16. A method as defined in Claim 10 wherein
2 the step of selecting a smoothing filter includes the
3 step of selecting a Gaussian filter.

1 17. A method as defined in Claim 10 wherein
2 the step of selecting a smoothing filter includes the
3 step of selecting a Kalman filter.

1 18. A method as defined in Claim 10 wherein
2 the step of selecting a smoothing filter includes the
3 step of selecting a box filter.